

Contents

Abstract	5
Symbolic notation	6
Preface	7
1. Introduction	9
1.1. Shells as structural elements	9
1.2. Geometry of a shell of revolution	10
1.3. Structural stability	12
1.4. Possibility of stabilisation of the post-buckling behaviour . . .	14
1.5. FE method in the stability analysis of shells	16
2. State of the art – literature review	19
2.1. Layout of the review	19
2.2. Buckling of doubly-curved shells	19
2.3. Post-buckling analysis of doubly-curved shells	27
2.4. Finite element method in stability analysis	29
3. Buckling behaviour of barrelled shells under various types of load	31
3.1. Geometry and FE model of the shell	31
3.2. External pressure	33
3.3. Axial compression	35
3.4. Pure bending	37
3.5. Torsion	38
4. Stability and post-buckling behaviour of single-layer barrelled shells under external pressure	41
4.1. Scope of the investigation	41
4.2. Geometry and FE model of the shell	41
4.3. Buckling shapes and buckling loads	43
4.3.1. Shells with positive Gaussian curvature	43
4.3.2. Shells with negative Gaussian curvature	46

4.4. Post-buckling behaviour of barrelled shells	49
4.4.1. General remarks	49
4.4.2. Shells with positive Gaussian curvature	50
4.4.3. Shells with negative Gaussian curvature	51
4.4.4. Imperfection sensitivity of barrelled shells	54
5. Stability of sandwich barrelled shells of constant thickness	57
5.1. Applications and properties of sandwich shells	57
5.2. Geometry and FE model of a sandwich barrelled shell of constant thickness	58
5.3. Shells with positive Gaussian curvature	60
5.4. Shells with negative Gaussian curvature	63
6. Stability of sandwich barrelled shells of variable thickness	67
6.1. Shells of variable thickness	67
6.2. Geometry and FE model of a sandwich barrelled shell of variable thickness	68
6.3. Shells with positive Gaussian curvature	71
6.4. Shells with negative Gaussian curvature	74
7. Final remarks	79
7.1. Summary of results	79
7.2. Perspectives of further investigation	80
Bibliography	83
Streszczenie	97